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EXAMINER	
SONG, MATTHEW J	

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1765	

9

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No. 09/873,041	Applicant(s) HEUKEN ET AL.
	Examiner Matthew J Song	Art Unit 1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

P ri d f r Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 29 April 2003 .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-21 is/are pending in the application.

4a) Of the above claim(s) 18 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-17 and 19-21 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Pri rity under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Objections

1. The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Misnumbered claims 18-20 been renumbered 19-21.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-17 and 19-21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 recites, "controlling the set of process temperatures wherein the set of process temperatures is selected from the group…." in lines 20-21. The term "set" is indefinite because the numerical value of "set" is unclear. The term "set" can be two or more.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are

> such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1-10 and 12-17 and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schmitz et al ("MOVPE growth of InGaN on sapphire using growth initiation cycles") in view of Burmeister (US 3,617,371).

Schmitz et al discloses a Metal organic chemical vapor deposition, MOCVD, for forming an AlGaInN alloy, where a variety of total flow rates and extremely precise temperature control and uniformity across the entire reactor and the substrate by means of a new multicoil heater system are used to achieve a film with excellent photoluminescence uniformity, this reads on applicant's controlling process parameters in the reaction chamber (Abstract). Schmitz et al also discloses an inductive heater brings a susceptor to a maximum temperature of 1600°C and very fast heat up and cooling cycles up to 6°C/sec can be achieved. Schmitz et al also discloses rapid cooling rates are enhanced because of reduced thermal mass susceptor, water cooled reactor chamber with all thermostated reactor walls. Schmitz et al also discloses reagents are separated in two carrier gas flows that combine at the injector and thermal management of the reactor in particular is a very critical parameter. Schmitz et al also discloses the injection zone is kept at a lower temperature to preserve less stable compounds (col 2-3), this reads on applicant's gas inlet. Schmitz et al also discloses accurate heat transfer calculation are critical because precursor decomposition and formation of deposits are determined by the temperature distribution in the MOCVD reactor. Schmitz et al also discloses precise temperature control of a quartz ceiling, this reads on applicant's upper side of the reaction chamber, inside the reactor is employed to keep the inner reactor wall, this reads on applicant's chamber walls, at a suitable elevated temperature

to minimize deposits and growth temperatures are adjusted with a precision of 0.1°C. Schmitz et al also discloses total flow rates and the gas flow ratio are used to optimize the growth rate and uniformities while growth rates can be adjusted independently (col 4-5). Schmitz et al also discloses absolute control over the ceiling temperature by employing an in situ monitoring and closed feedback control system and a sensor from 400 to 1900°C with a resolution to 0.1 °C is used, this reads on controlling the temporal variation of the set of process temperatures, and it is possible to monitor the temperature profile of the wafer, satellite and planetary disc and a RF heater is adjustable such that the temperature uniformity of the satellite and planetary disc is optimized, this reads on applicant's first and second wafer support (col 9-12). Schmitz et al also discloses a multiwafer planetary reactor with a rotating susceptor and an exhaust (fig 1).

Schmitz et al does not disclose a gas mixing system and a temperature variation of said gas mixing system.

In a method of growing a III-V layer by vapor phase epitaxy, note entire reference, Burmeister teaches a vapor phase reactor includes separately arranged source, mixing **45** and growing chambers which may be selectively heated inductively to eliminate contaminating decomposition of the reactor walls (col 1, ln 1-67). Burmeister also teaches RF heating coils **65** may be varied to concentrate the heating power at selected portion of the length of the walls and the portion adjacent the mixing chamber operates at approximately 800°C and the term approximately is intended to include values within + 10 percent of the stated value. Burmeister also teaches a temperature sensing means **71** may be connected to a thermocouple **69** for giving a temperature indication or for controlling the RF power from source **67** where desired to maintain close control of operating temperature (col 2, ln 1-75). It would have been obvious to a person of

ordinary skill in the art at the time of the invention to modify Schmitz et al with Burmeister's mixing chamber to eliminate contaminating decomposition of the reactor walls (col 1, ln 25-40).

Referring to claim 1, the combination of Schmitz et al and Burmeister et al teach controlling the temperature of a reactor, which includes thermal control of a gas inlet, the chamber walls, a first and second wafer support, a upper side of a reaction chamber and a gas mixing system. This reads on controlling the set of process temperature wherein the set of process temperature is selected from the group consisting of T1, T2, T3, T4, T5, T6, T7 and T8 because the term "set of process temperatures" is interpreted to mean two or more parameters selected from the claimed group. The combination of Schmitz et al and Burnmeister teach controlling at least two parameters, for example the upper side of the reaction chamber and the gas mixing system, therefore meets the limitations of claim 1.

Referring to claim 2, the combination of Schmitz and Burmeister does not teach controlling the temperature T_1 below the condensation temperature of the gases and by adjustment of the temperature for avoiding the formation of addition compounds. Schmitz et al discloses the injection zone is kept at a lower temperature to preserve less stable compounds (col 2-3). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Schmitz et al and Burmeister by injecting the reactants at a temperature below the condensation temperature to preserve less stable compounds, which would also avoid formation of addition compounds.

Referring to claim 3, the combination of Schmitz et al and Burmeister teach all of the limitations of claim 3, as discussed previously, except control of temperature T_2 as equal to the temperature of T_3. Schmitz et al teaches the precise control of the quartz ceiling inside the

reactor is employed to keep the inner reactor wall at a suitable temperature (700-950°C), which allows to minimize deposits (col 5). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Schmitz et al and Burmeister to have the principle wafer support equal the temperature of the chamber wall to minimize the deposits of the wafer support. Furthermore, temperature is a result effective variable that can be optimized through routine experimentation (MPEP 2144.05).

Referring to claim 4, Schmitz et al discloses an inductive heater brings the susceptor to a maximum temperature of 1600°C and heat-up and cooling cycles up to 6°C/sec (360°C/min) can be achieved (col 2-3) and it is necessary to hold temperature constant for good quality epitaxial layers (col 10).

Referring to claim 5, Schmitz et al disclose a sensor with a resolution to 0.1°C is used and it is possible to monitor the temperature profile of the wafer, satellite and planetary disc and adjusting the heater such that the temperature uniformity of the wafer and satellite disc is optimized, this reads on applicant's controlling the temperature of the individual wafer supports, satellites, in correspondence to the temperature T_3, the planetary disc.

Referring to claim 6, the combination of Schmitz et al and Burmeister teach all of the limitations of claim 6, as discussed previously, except controlling the temperature of T_5 to a value smaller than the value of the temperatures T_4 and T_5. The temperature of the wafer supports requires a large amount of heat for decomposition of reactant gases and deposition, but the gas outlet does not have this requirement because no deposition is desired at the gas outlet; therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Schmitz et al by heating the gas outlet to a temperature less than T_4 to save energy and

reduce operating costs. Also temperature is a result effective variable, which can be optimized through routine experimentation (MPEP 2144.05).

Referring to claim 7, Schmitz et al teaches the reagents are separated in two gas flows that combine at the injector and the injection zone is kept at a lower temperature to preserve less stable compounds (col 3).

Referring to claim 8-9, Schmitz et al discloses it is necessary to hold the ceiling, the upper side of the reaction chamber, temperature constant to be sure about the thermal condition of the susceptor surface and wafer, this reads on applicant's correlates to T_3 (col 10). The closed feedback control system, this reads on applicant's heating system, provides control over the ceiling temperature.

Referring to claim 10, Schmitz et al discloses total flow rates are used to optimize growth rates and uniformities can be adjusted independently, this reads on applicant's controlling a temperature dependent gas flow variation (col 5).

Referring to claim 12, Schmitz et al discloses controlling a temperature dependent principle carrier gas variation in the reaction chamber (Fig 6).

Referring to claim 13, Schmitz et al discloses controlling temperature GaN/InGaN growth (Fig 17) during substrate cleaning, nitridization, buffer layer growth and film growth, this reads on applicant's controlling temperature dependent interrupts in the production process because production is interrupted between layers and temperature control is maintained.

Referring to claim 14, Schmitz et al discloses substrates of Al_2O_3, SiC and Si, this reads on applicant's other material resistant to temperature and process gases.

Referring to claim 15, Schmitz et al discloses substrate cleaning and nitridization and growing a buffer layer (col 17), this reads on applicant's surface treatment or covering the surface with other materials or material components.

Referring to claim 16, Schmitz et al discloses growing a buffer layer at 500°C and growing GaN at 1000-1100°C using ammonia and trimethyl gallium (col 15 and col 17), this reads on applicant's two stage application of materials.

Referring to claim 17, Schmitz et al discloses the injection zone is kept at a lower temperature to preserve less stable compounds, this reads on applicant's temperature controlled injector.

Referring to claims 19-20, Schmitz et al teaches an inductive heater brings a susceptor, this reads on applicant's first wafer support, to a maximum temperature of 1600°C and very fast heat up and cooling cycles up to 6°C/sec (360°C/min) can be achieved. Overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 21, Schmitz et al teaches growth temperatures are adjusted with a precision of 0.1°C

6. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schmitz et al ("MOVPE growth of InGaN on sapphire using growth initiation cycles") in view of Burmeister (US 3,617,371) as applied to claims 1-10 and 12-17 above, and further in view of Takai et al (US 5,402,748).

The combination of Schmitz et al and Burmeister teaches all of the limitations of claim 11, as discussed previously, except additionally controlling a temperature dependent total pressure variation in the reaction chamber.

In a method of growing a semiconductor film, note entire reference, Takai et al teaches a GaAs buffer layer **22** is grown on a Si substrate **21** while supplying TMG and AsH_3 and the supply of TMG is interrupted and the temperature is elevated to about 650°C while controlling the total pressure of AsH_3 (col 8, ln 35-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Schmitz et al and Burmeister with Takai et al to control the total pressure to guarantee satisfactory flatness in the surface of a layer on top of the buffer layer (col 8, ln 50-67).

Response to Arguments

7. Applicant's arguments filed 4/29/2003 have been fully considered but they are not persuasive.

Applicant's argument that Schmitz et al and Burnmeister fail to teach all the elements of claim 1 has been noted but has not been found persuasive. Claim 1 recites, "controlling a set of process temperatures wherein the set of process temperatures is selected from the group consisting of the temperature of the gas inlet, the temperature of the chamber walls, the temperature of the first wafer support, the temperature of the second wafer support, the temperature of the gas outlet, the temperature of the gas mixing system, the temperature of the upper side of the reaction chamber and the temperature of the heating system". The term "set" has been interpreted by the Office to mean two or more; therefore this limitation has been

interpreted by the Office to mean controlling two or more process temperatures wherein the two or more process temperatures is selected from the claimed group. The combination of Schmitz et al and Burnmeister teach controlling the temperature of a reactor, which includes thermal control of a gas inlet, the chamber walls, a first and second wafer support, a upper side of a reaction chamber and a gas mixing system. The combination of Schmitz et al and Burnmeister teach controlling at least two parameters, for example the upper side of the reaction chamber and the gas mixing system, therefore meets the limitations of claim 1.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Frijlink (US 5,108,540) teaches a device **20** for controlling the temperature of wall opposite a susceptor.

Flemish et al (US 5,256,595) teaches a hot wall reactor with four temperature zones for deposition, mixing, preheating and injection, where gas flows are controlled by a microprocessor (col 2-3).

Molnar (US 6,086,673) teaches exhaust lines are at a sufficiently high temperature to prevent clogging reactor exhaust lines (col 4, ln 55-67).

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
July 3, 2003

BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
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